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(71) Applicant
**Montedison SpA
31 Foro Buonaparte
Milan
Italy**

(72) Inventors
**Isidoro Ronzoni
Domenico Di Diego
Gerardo De Luca
Romeo Vallati**

(74) Agents
**Marks & Clerk
57-60 Lincoln's Inn
Fields
London
WC2A 3LS**

(54) Laminated thermoplastic product and articles produced therefrom

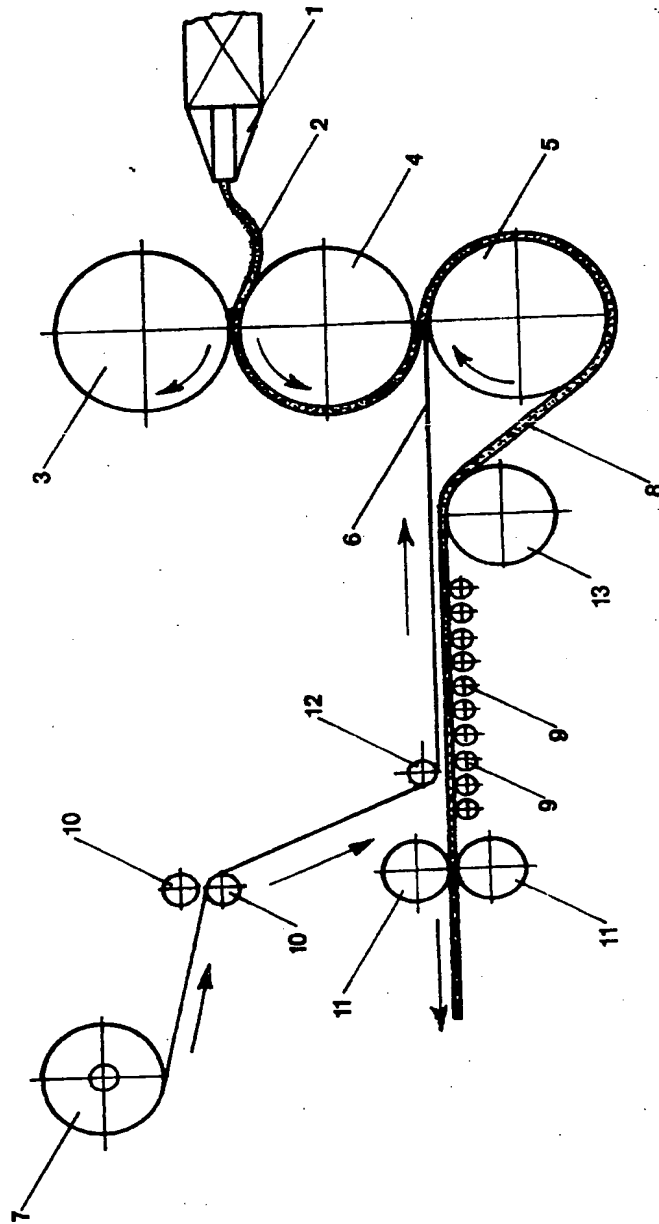
(57) A laminated product made of thermoplastic material, which comprises at least one layer of polymethylmethacrylate and at least one layer of high-impact polymethylmethacrylate.

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SPECIFICATION

Laminated thermoplastic product and articles produced therefrom

- 5 The present invention relates to a laminated product made of thermoplastic material and to finished articles produced therefrom. More particularly the invention relates to a laminated product made of polymethylmethacrylate (PMMA) having improved mechanical characteristics and easy processability, as well as to finished goods obtained therefrom by thermomolding.
- 10 It is known to produce PMMA sheets by extrusion and successive calendering through sets of rollers. Likewise, it is known to produce from such sheets shaped articles such as hydrosanitaires (baths, kitchen sinks, wash basins, shower footboards and partitions), luminous publicity sign boards, light fittings (such as ceiling lights), skylights and light domes, and partition panels for furnishings and for the building industry. Such articles are generally obtained by the known thermomolding technique, by heating the PMMA sheets and shaping them in suitable molds.
- 15 The heating of the sheets in general is carried out in an oven in which the sheets are arranged vertically, suspended by their upper ends with suitable pincers. In the first few minutes of the heating, the heat causes dimensional shrinkage of the sheets, due to settling of the internal stresses occurring during the extrusion stage of the sheets and the successive calendering. After this settling, owing to the temperature attained by the sheets under operating conditions (a temperature which is higher than the glass-transition temperature of the material), there occurs an elongation stage of the sheets themselves, caused by creep of the material. In the case of PMMA sheets, when applying the usual heating times, there were found to occur elongations greater than 10%, with ensuing dimensional variations and problems in the successive thermomolding processing of the desired articles.
- 25 Moreover, the finished products thus obtained display excellent aesthetic characteristics and good weatherproof properties, but have poor mechanical resistance characteristics; for instance they have a low impact resistance.
- In some applications, such as in the production from PMMA sheets of hydrosanitaires, it is important that the article obtained therefrom also has good mechanical characteristics; it is important that the articles not only have a good rigidity, which may be achieved by reinforcing the manufactured articles with a polyester resin, for instance containing glass fibres, but that it also has a good impact resistance.
- 30 The present invention provides a laminated product made of thermoplastic material, which comprises at least one layer of polymethylmethacrylate and at least one layer of high-impact polymethylmethacrylate.
- 35 In the laminated product the high-impact polymethylmethacrylate layer preferably appears as a substrate.
- The polymethylmethacrylate (PMMA) layer suitably comprises a methacrylic based resin obtained by a known conventional polymerization method (suspension, emulsion polymerization, etc) and may comprise a homopolymer of methylmethacrylate or a copolymer of methylmethacrylate preferably with methyl- or ethylacrylate, in quantities varying from 2% to 10% by weight.
- 40 The high-impact PMMA layer preferably comprises a methacrylic based resin in which are homogeneously dispersed particles of an acrylic-based elastomer; the resin is itself known and is prepared according to a well known polymerization and grafting process.
- 45 The laminated product of the present invention may be suitably obtained by coupling together by a well known system, for instance by calendering under heat an extruded PMMA sheet with a high-impact polymethylmethacrylate film.
- For the preparation of both the PMMA sheet and the high-impact polymethylmethacrylate film suitable already known materials are commercially available. For instance, for the production of the PMMA sheet there may be a conveniently used the polymethacrylic resin produced by Montedison S.p.A. under the name "VENDRIL" (Registered Trade Mark), while for the production of the high-impact polymethylmethacrylate film there may be used the high-impact polymethacrylate OROGLAS DR 100EG resin (Registered Trade Mark) produced by Röhm & Haas.
- 50 The laminated product of the present invention is preferably produced by coupling together an extruded PMMA sheet, directly during the heat calendering stage of the sheet being extruded, with a high-impact polymethylmethacrylate film previously produced by either calendering or by extrusion.
- 60 The thickness of the polymethylmethacrylate film depends on the type of product that it is desired to obtain, and is generally from 0.2 to 1.0 mm.
- The invention will be further described, by way of example only, with reference to the accompanying drawing, which schematically illustrates a process for the preparation of a laminated product of the present invention.
- 65 In the process shown in the drawing PMMA is extruded by an extruder 1, in the form of a

sheet 2, which is then passed between calendering cylinders 3, 4 and 5 of a calender. During the passage of the sheet between the calendering cylinders 4 and 5, there is effected its stable coupling with a high-impact polymethylmethacrylate film 6 which comes from a reel 7.

The thus obtained coupled product 8 is then cooled down on cooling rollers 9, to obtain the final laminated product of the invention.

Reference numbers 10 and 11 indicate dragging rollers respectively for the high-impact film and for the laminated product, while reference numbers 12 and 13 respectively indicate guiding rollers.

Using the polymethacrylic resin VEDRIL, produced by Montedison S.p.A., and a high-impact film obtained from the OROGLAS DR 100 EGG resin produced by Röhm & Haas, there have been produced laminated products by the process described above.

There were then prepared sheets having a total thickness of 3 and 5 mm, in which the thickness of the high-impact film was respectively 0.3, 0.6, 0.8 and 1.0 mm. Following the same procedures there were then prepared sheets of the same thickness of 3 and 5 mm, but without the high-impact film.

From these sheets were then prepared test pieces to be subjected to impact-resistance tests according to the British Standards Institution, BS-2782 -306/B. The tests were conducted by subjecting the test pieces to impacts on the side opposite to that of the high-impact film.

The results that were obtained are given in the Table below.

TABLE

TEST No	Total Thickness of sheets in mm	Thickness of high impact film in mm	Impact resistance Kg cm/cm
1	3	—	13.2
2	3	0.3	16.0
3	3	0.6	21.6
4	3	0.8	23.7
5	3	1.0	24.3
6	5	—	18.7
7	5	0.3	23.1
8	5	0.6	26.4
9	5	0.8	27.8
10	5	1.0	31.5

From the above table it is clearly apparent that the laminated products of the present invention (tests 2 to 5 and 7 to 10) have an improved impact resistance with respect to the sheets made of polymethylmethacrylate only (tests 1 and 6).

The laminated products obtained according to the present invention have been subjected to heating, in order to be successively heat-molded into articles of various types, and no significant elongation could be detected at the end of the heating itself.

CLAIMS

1. A laminated product made of thermoplastic material, which comprises at least one layer of polymethylmethacrylate and at least one layer of high-impact polymethylmethacrylate.

2. A laminated product as claimed in claim 1, wherein the high-impact polymethylmethacrylate layer is a substrate.

3. A laminated product as claimed in claim 1 or 2, wherein the polymethylmethacrylate is a homopolymer of methylmethacrylate.

4. A laminated product as claimed in claim 1 or 2, wherein the polymethylmethacrylate is a copolymer of methylmethacrylate with methyl- or ethylacrylate.

5. A laminated product as claimed in any one of claims 1 to 4, wherein the high-impact polymethylmethacrylate comprises a methacrylic resin in which are dispersed particles of an elastomer.

6. A laminated product as claimed in any of claims 1 to 5, wherein the high-impact polymethylmethacrylate is a film.

7. A laminated product as claimed in claim 6, wherein the said film has a thickness of from 0.2 to 1.0 mm.

8. A laminated thermoplastic product according to claim 1, substantially as herein described.

9. A manufactured article obtained by using a laminated product as claimed in any of claims 1 to 8.

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